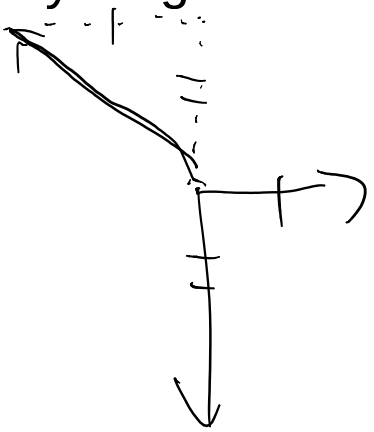
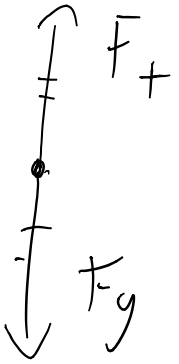
Free body diagrams

1.

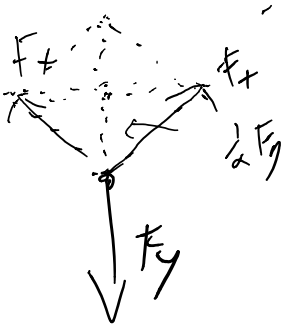


Q2

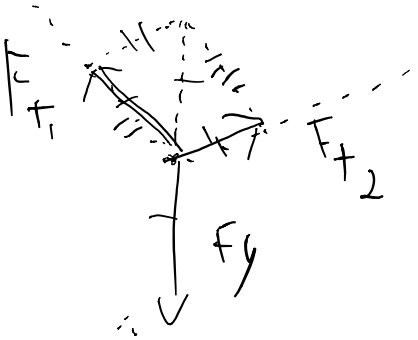


Q3

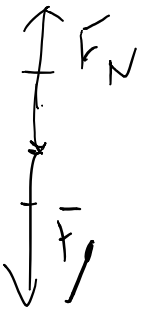
Q4



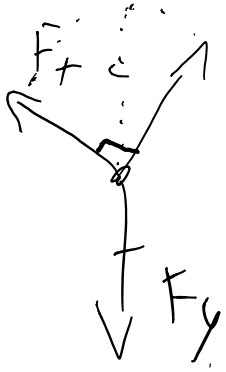
Q5



Q6



Q7

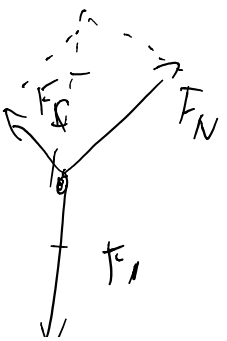


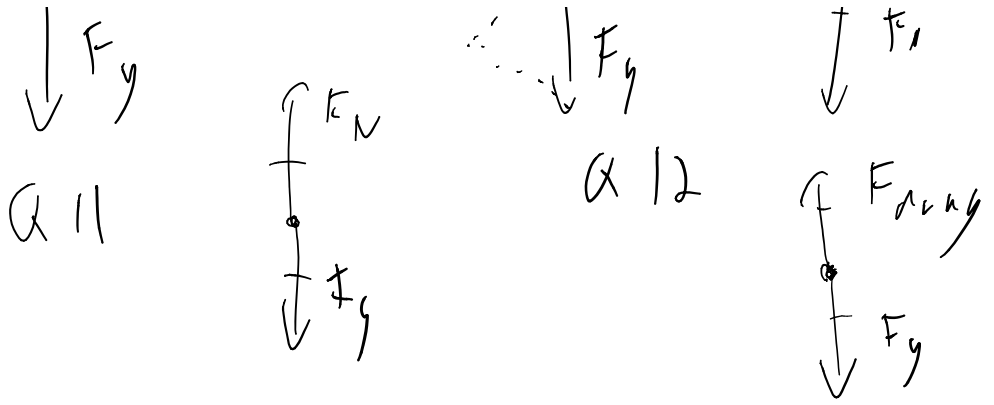
Perpendicular to surface

Q8

Q9

10





Chapter 4 Dynamics in 2 dimensions

Dynamics: the study of forces
Force: a push or a pull, measured in Newtons, N = kgm/s^2
net force, F_{net} is the vector sum of all forces
$F_{net} = \Sigma F$ draw a vector addition diagram with the force vectors head to tail
Free body diagram - shows the force vectors

Newton's Three Laws:
First: Law of Inertia: Objects in motion tend to stay in constant speed and constant direction motion unless unbalanced forces act on them. F_{net} = not zero

Second: Law of acceleration
$F_{net} = ma = \Delta p/\Delta t$
if the vector sum of all forces is not zero, objects will accelerate proportionally to the resultant force and inversely to the mass.
- the momentum will change proportionally as well.

Third: Action - Reaction Law
For every force object A exerts on object B,

object B reacts with an equal and opposite force on A.
How can objects accelerate if the forces are equal and opposite? Don't they cancel out?

The forces are on different objects.

eg. You pull a 2.0 kg cart with 3.0 N of force.
a) if there is no friction, what is the acceleration of the cart?
b) what is the weight of the cart?
c) if the 2.0 kg cart accelerates at 1.0 m/s^2 when you pull at 3.0N, what is the force of friction on the cart? What is the coefficient of kinetic friction, μ_k of the cart?
d) if I add 4.0 kg to the cart and the coefficient of static friction is 0.10, what is the minimum force required to get the cart rolling?
e) if I then push down on the cart (part d) with 20.0N, what is the new minimum force?

$F_{net}=ma = \Sigma F$

$F_f= \mu F_N$

$F_g=mg$

p62 problems 3,5,9,15,17,27,29

a) f=ma a=f/m = 3N/2kg = $1.5 m/s^2$
b) Fg=mg = 2.0kg x 9.8N/kg = 19.6N
= $2.0 \times 10^1 N$
c) Fnet = ma = sum of all forces = Fa-Ff
Fnet = 2.0kg(1.0m/s^2) = 3N - Ff
Ff=3-2= 1.0N

Fnet = 2.0kg(1.0m/s^2) = 3N - Ff

Ff=3-2= 1.0N

coefficent = Ff/Fn = Ff/Fg = 1.0N/19.6N

= 0.051

d) Ff=0.10 x (2kg + 4kg)9.8N/kg

Ff= 0.1x6x9.8=5.88

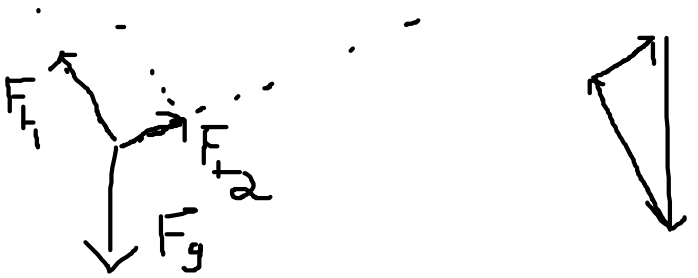
Ff=5.9N=minimum applied force

e) Fn = Fg + 20N = 6x9.8=58.8 +20 = 78.8N

Ff= 0.1x78.8=7.88 = 7.9N

$d=1/2gt^2 + v_{yi}t$

$10m = 1/2(-9.8)t^2 + 20 \sin(35)\, t$



normal force is the component of the force of the ground perpendicular to its surface. It responds to the force the object pushes on the surface.

Chapter 4 Dynamics

What is dynamics?

Study of forces.

What's a force? A push or pull that can cause a change in motion or energy.

units: Newton, N = kgm/s^2
Write out Newton's 3 Laws:
Newton's First Law
Law of Inertia:
Objects tend to stay at constant speed and constant direction motion or at rest, unless external unbalanced force is applied. $F_{net} = \Sigma F$ = vector sum of all forces
- use vector addition diagrams - draw head to tail
if $F_{net} = \Sigma F = 0$, then speed and direction are constant

Newton's Second Law
Law of Acceleration
When a mass is accelerated, the acceleration is proportional to the net force and inversely proportional to the mass.
$a = F_{net}/m$ or $F_{net} = ma$ = rate of change in momentum
$F_{net} = ma = \Delta p/\Delta t$ rate of change in momentum

Newton's Third Law
Action-Reaction Law
When object A pushes or pulls object B, object B responds with an equal and opposite force on object A.

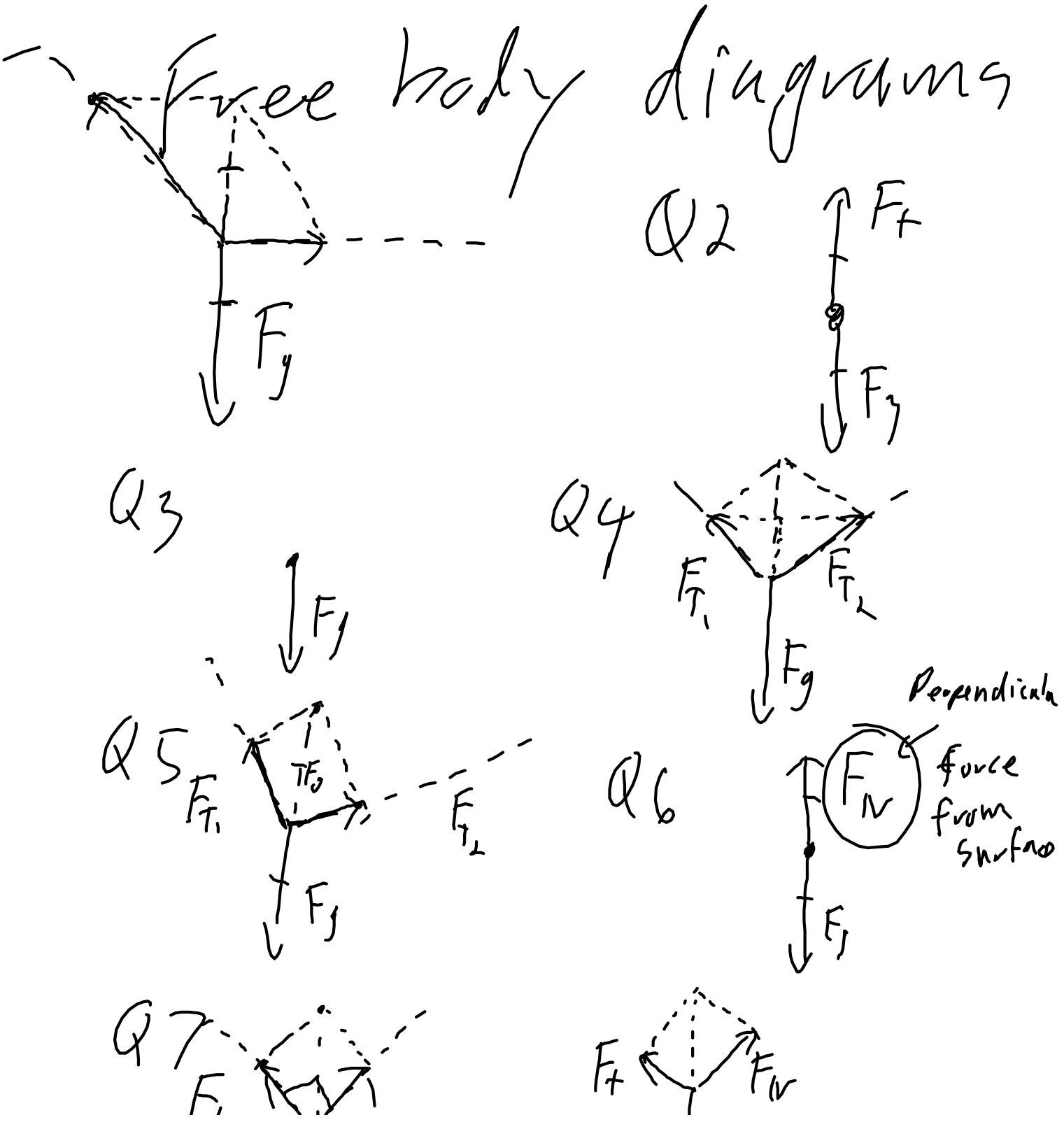
If the forces are equal and opposite, isn't the net force 0? How do things accelerate? - the forces are on different objects.

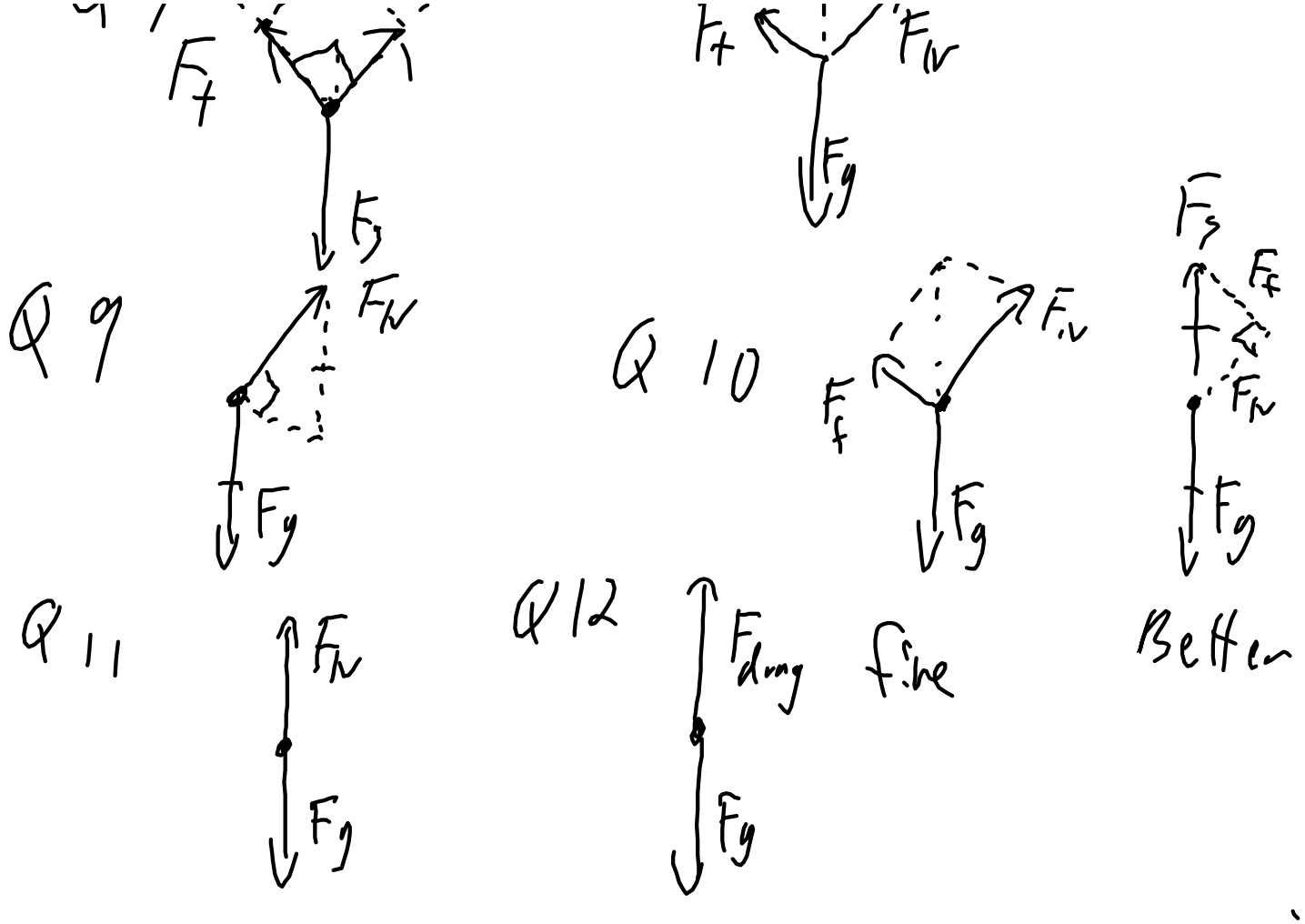
Ph 11 review

block 2-4
projectile simulation lab

free body diagram sheet
dynamics review

Q5
$dy = 1/2gt^2 + vyit$ only works if there is no air resistance
$10m = 1/2\ (-9.8m/s^2)t^2 + (20m/s \sin 35\ )\ t$
solve for t and compare to the value off the simulation





Chapter 4 Dynamics

Dynamics is: study of forces.

Force is a push or a pull - can cause changes in motion or energy.

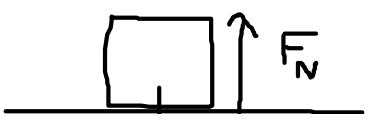
units: Newtons, N = kgm/s^2

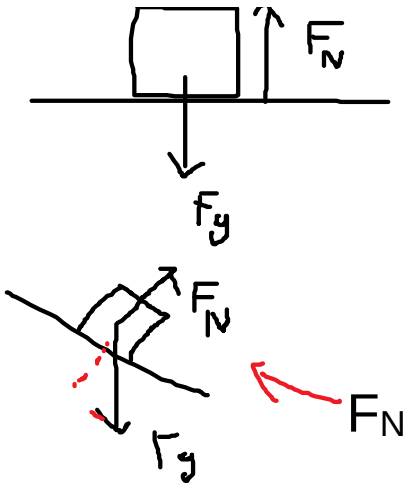
Gravitational force, $F_g = mg$ where g=9.80 N/kg near Earth

$F_g = GMm/r^2$ in general with $G= 6.67 \times 10^{-11} Nm^2/kg^2$

tension force, F_t in a string or cable = at both ends for a massless string

Normal force, F_N, the force of a surface perpendicular responding to the force on the surface.





$F_N=F_g$ if it is a level surface, not accelerating, no other forces

F_N is not = to F_g

$F_f=\mu F_N$
friction is the component of the surface force parallel to the surface. Opposes sliding motion.
μ is the coefficient of friction - depends on the surfaces

What are Newton's Three Laws?
First Law: Law of Inertia.
Objects stay in constant speed constant direction motion unless acted upon by unbalanced forces.
$F_{net}=\Sigma F$ =vector sum of all forces
if $F_{net}=0$ then the velocity of the object is constant.

Second Law: Law of acceleration
The acceleration of an object is proportional to the vector sum of all forces on the object and inversely proportional to the mass.
$a=F_{net}/m$
$F_{net}=\Sigma F = ma = \Delta p/\Delta t$ the rate of change in momentum

Third Law: Action-Reaction Law
For every force object A acts on object B, object B applies and equal and opposite force on object A.